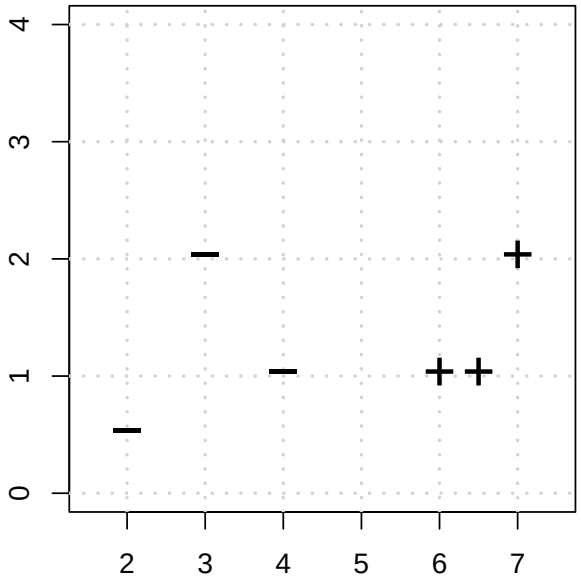
**Exercise 1: Hard Margin Classifier**

The primal optimization problem for the two-class hard margin SVM classification is given by

$$\begin{aligned} \min_{\theta, \theta_0} \quad & \frac{1}{2}||\theta||^2 \\ \text{s.t. :} \quad & y^{(i)} \left( \left\langle \boldsymbol{\theta}, \mathbf{x}^{(i)} \right\rangle + \theta_0 \right) \geq 1 \end{aligned}$$




(a) Calculate the following quantities:

- $\gamma$
- $\|\boldsymbol{\theta}\|$
- $\boldsymbol{\theta}$
- $\theta_0$
- Determine which points are support vectors.

(b) What may change in (a) if the following things happen:

- All points are rotated by 45 degrees counterclockwise.

- All points are shifted by 2 to the right (in the x-axis).

- One SV moves closer to the separating hyperplane.

- One SV is removed from the dataset.